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Archimedean-type force in a cosmic dark fluid. I. Exact solutions for the late-time accelerated expansion

Balakin A., Bochkarev V.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

We establish a new self-consistent model in order to explain from a unified viewpoint two key features of the cosmological evolution: the inflation in the early Universe and the late-time accelerated expansion. The key element of this new model is the Archimedean-type coupling of the dark matter with dark energy, which form the so-called cosmic dark fluid. We suppose that dark matter particles immersed into the dark energy reservoir are affected by the force proportional to the four-gradient of the dark energy pressure. The Archimedean-type coupling is shown to play a role of effective energy-momentum redistributor between the dark matter and the dark energy components of the dark fluid, thus providing the Universe evolution to be a quasiperiodic and/or multistage process. In the first part of the work we discuss a theoretical base and new exact solutions of the model master equations. Special attention is focused on the exact solutions, for which the scale factor is presented by the anti-Gaussian function: these solutions describe the late-time acceleration and are characterized by a nonsingular behavior in the early Universe. The second part contains qualitative and numerical analysis of the master equations; we focus there on the solutions describing a multi-inflationary Universe.

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